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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/720,457	11/24/2003	Cha Deok Dong	29936/39764	4077
4743 7590 03/21/2008 MARSHALL, GERSTEIN & BORUN LLP 233 S. WACKER DRIVE, SUITE 6300 SEARS TOWER CHICAGO, IL 60606			EXAMINER TRINH, MICHAEL MANTH	
			ART UNIT 2822	PAPER NUMBER
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary**Application No.**

10/720,457

Applicant(s)

DONG, CHA DEOK

Examiner

Michael Trinh

Art Unit

2822

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 08 January 2008.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-14 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-14 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SF/ICE)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

*** This office action is in response to Applicant's Amendment and RCE filed January 08, 2008. Claims 1-14 are pending.

*** The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Abstract Objection

1. The abstract is objected to as it is not limited to a single paragraph and within a range of 50 to 150 words. Appropriate correction is required.

Claim Rejections - 35 USC § 103

2. Claims 1 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wu (2002/0115270) in view of Oda et al (2002/0086498).

Wu teaches a method for forming a device isolation film in a semiconductor device, comprising the steps of: performing a first ion implantation process for controlling a threshold voltage in an active region of a semiconductor substrate 100 (Figs 4A-4F, paragraphs 20-23,19; 3A,3C, paragraph 0014); sequentially forming a gate oxide film 201 and a polysilicon film 202 over the semiconductor substrate 100 (Fig 4A-4F; paragraphs 20-23); forming a trench having sidewall to define the active region and a device isolation region by etching a portion of the polysilicon film 202, the gate oxide film 210, and the semiconductor substrate 100 (Figs 4B-4D; paragraph 20); performing a second ion implantation into the semiconductor substrate of the active region beside the trench and vertically overlapped with the polysilicon film. Re claim 5, wherein boron is used as an ion for implanting to control the threshold voltage (paragraph 0014).

In Figure 4D Wu, the ion implanted region 200b does not vertically overlap with the polysilicon layer 202a.

However, Oda teaches (at Fig 3; paragraphs 46, 44-47; Figs 1-4) performing a second ion implantation into the active region, without having an extended buffer spacers at the trench sidewall, in order to compensate for the ions for controlling a threshold voltage, which ions are diffused from the active region (Figs 1-4; paragraphs 46,44-47, 10,15,20).

Therefore, one of ordinary skill in the art at the time the invention was made would realize and recognize that by forming the semiconductor device of Wu without having the

extended buffer spacers as evidently taught by Oda, wherein ions are implanted into the semiconductor substrate at the active region and vertically overlapped the polysilicon film at the corner portions of the trench, and thereby affecting and compensating for the previous implanted ions for controlling a threshold voltage. This is because of the desirability to inhibit a threshold voltage form fluctuation in upper corner portions of the trench isolation region.

3. Claims 6,14 are rejected under 35 U.S.C. 102(b) as being anticipated by Wu (2002/0115270) and Oda (2002/086498), as applied to claims 1,5 above, taken with Sung (5,550,078).

Wu and Oda teach methods for forming a semiconductor devices are described above, and as applied to claims 1 and 5 above, and fully repeated herein, wherein Wu also teaches sequentially forming a gate oxide film 201, a polysilicon film 202, and a pad nitride 203 on the semiconductor substrate 100 (Fig 4A; paragraphs 0020); and after removing the pad nitride 203a (paragraph 0022), forming a device isolation film (106 in Fig 3E; 206 in Fig 4E) by burying the oxidation film inside the trench (Figs 3E-3F, paragraph 0017; Figs 4A-4F, paragraphs 0020-0021). Re claim 14, wherein boron is used as an ion for implanting to control the threshold voltage (paragraphs 0014 and 20).

Wu teaches ion implanting to form threshold voltage (Fig 4A), but does not clearly mention forming a screen oxide film before implantation and removing it thereafter.

However, Sung teaches (at Figs 4-6; col 5, line 55-67; col 6) forming a screen oxide film 9 to protect the semiconductor substrate (Fig 5); performing an ion implantation for controlling a threshold voltage 10; and removing the screen oxide film 9 thereafter.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to perform an ion implantation for controlling a threshold voltage of Wu by forming a screen oxide film before ion implantation and removing it thereafter, as taught by Sung. This is because of the desirability to protect the semiconductor substrate from damaging due to the ion implantation.

4. Claims 2,11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wu (2002/0115270) and Oda et al (2002/086498), as applied to claims 1,5 above, and further Sung (5,550,078), as applied to claim 6 above.

Wu and Oda, as applied to claim 1, and further of Sung as applied to claim 6, teach a method for forming a device isolation film in a semiconductor device, and repeated herein.

Re claims 2,11, Wu already teaches performing an oxidation to form the sidewall oxidation film 105 having a thickness in a range of 50 to 150 Angstroms. Wu does not mention the oxidation to round an upper portion or bottom corner of the trench.

However, Oda et al further teach (at Figs 2, paragraph 0045; Figs 3-9; paragraphs 0046-0052) when forming the trench, the side wall oxidation film 5 formed by oxidation to perform a rounding treatment to round on an upper corner portion of the trench, and to suppress fluctuation of a threshold voltage in an upper corner portion of the trench isolation (paragraphs 0017-0021), wherein bottom corners of the trench is inherently rounded during the same oxidation step, and wherein an adhesive strength of the oxidation film to be buried inside the trench is also inherently increased due to the formation of the sidewall oxidation film.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the device isolation film in a semiconductor device of Wu by rounding the upper portion or corners of the trench at the same time during the oxidation step to the sidewall oxidation film as taught by Oda et al. This is at least because of the desirability to suppress fluctuation of a threshold voltage in an upper corner portion of the trench isolation. Also, the subject matter as a whole would have been obvious to one of ordinary skill in the art at the time the invention was made to select the portion of the prior art's range of thickness in a range of 50 to 150 Angstroms, as disclosed by Wu, which is within the range of applicant's claims, because it has been held to be obvious to select a value in a known range by optimization for the best results, and would be an unpatentable modification, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation". *In Re Aller* 104 USPQ 233,255 (CCPA 1955); *In re Waite* 77 USPQ 586 (CCPA 1948); *In Re Swanson* 56 USPQ 372 (CCPA 1942); *In Re Sola* 25 USPQ 433 (CCPA 1935); and *In Re Dreyfus* 24 USPQ 52 (CCPA 1934).

5. Claims 3,12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wu (2002/0115270) and Oda et al (2002/086498), as applied to claim 1, and further of Sung (5,550,078), as applied to claims 1,6 above, taken with Hong (6,030,882).

Wu and Oda, as applied to claim 1, and further of Sung as applied to claim 6, teach a method for forming a device isolation film in a semiconductor device, and repeated herein.

Re claims 3,12, Wu already teaches performing an oxidation to form the sidewall oxidation film, but lacks mentioning by a dry oxidation at a temperature of 800-900°C.

However, Hong teaches (at Figs 2C-2D; col 4, lines 13-25) forming a sidewall oxidation film 218 on sidewalls of the trench by dry oxidation at a temperature of about 900°C.

Therefore, the subject matter as a whole would have been obvious to one of ordinary skill in the art at the time the invention was made to select the portion of the prior art's range of temperature of about 900°C in the dry oxidation to form the sidewall oxidation film on sidewalls of the trench, as disclosed by Hong, which temperature is within the range of applicant's claims, because it has been held to be obvious to select a value in a known range by optimization for the best results, wherein the implanted ions are prohibiting from diffusion at that temperature, and would be an unpatentable modification, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation", *In Re Aller* 104 USPQ 233,255 (CCPA 1955); *In re Waite* 77 USPQ 586 (CCPA 1948); *In Re Swanson* 56 USPQ 372 (CCPA 1942); and *In Re Dreyfus* 24 USPQ 52 (CCPA 1934); wherein the dry oxidation is effectively process for forming a thin uniform sidewall oxidation film on the sidewalls of the trench as a liner oxide layer.

6. Claims 4,13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wu (2002/0115270) and Oda et al (2002/086498), as applied to claim 1, and further of Sung (5,550,078), as applied to claims 1,6 above.

Wu and Oda, as applied to claim 1, and further of Sung as applied to claim 6, teach a method for forming a device isolation film in a semiconductor device, and repeated herein.

Re claims 4,13, Wu already teaches performing an ion implantation process on an active region after the oxidation process, but lack mentioning the implantation at a dose of $1\text{E}11$ to $1\text{E}12$ ion/cm² in an energy band of 10 Kev to 25 Kev.

However, Oda et al also teaches performing an ion implantation process on an active region after the oxidation process, wherein the implantation is performed at a dose of 5×10^{11} to 1×10^{14} ion/cm² in an energy band of 10 Kev to 30 Kev.

Therefore, the subject matter as a whole would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the ion implantation of Wu by selecting the portion of the prior art's range of dose and energy, as disclosed by Oda et al, which is within the range of applicant's claims, because it has been held to be obvious to select a value in a known range by optimization for the best results, and would be an unpatentable modification, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation". *In Re Aller* 104 USPQ 233,255 (CCPA 1955); *In re Waite* 77 USPQ 586 (CCPA 1948); *In Re Swanson* 56 USPQ 372 (CCPA 1942); and *In Re Dreyfus* 24 USPQ 52 (CCPA 1934).

7. Claims 7,10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wu (2002/0115270), Oda et al (2002/086498), and Sung (5,550,078), as applied to claim 6 above, and further of Houlihan (2001/0021545) or Dong (2003/0119256).

The references including Wu, Oda et al and Sung teach a method for forming a device isolation film in a semiconductor device, as applied to claim 6 above.

Re claims 7, the references teach forming the screen oxide, but lack mentioning thickness of about 50-70 Angstroms by wet or dry oxidation at 700-900° C. Re claim 10, Wu already teaches forming the pad nitride film 203 by low pressure chemical vapor deposition, but lack mentioning a thickness of about 900-2000 Angstroms.

However, re claim 7, Sung already teaches forming a screen oxide film 9 having a thickness of about 150-250 Angstroms by thermal oxidation at 850-950° C (col 4, lines 55-65). Houlihan teaches (at col 4, lines 63-67) forming a screen oxide film 24 having a thickness of about 50-100 Angstroms. Re claim 10, Houlihan also teaches forming the pad nitride film 27 having a thickness of about 800-1000 Angstroms (col 5, lines 12-15). Dong also teaches (at paragraph 25) forming a screen oxide film 26 having a thickness of about 50-70 Angstroms by wet or dry oxidation at 700-900 °C (re claim 7), wherein a pad nitride 16 is formed by LPCVD (paragraph 13, re claim 10).

Therefore, the subject matter as a whole would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the screen oxide film and the pad nitride film of the references including Wu by selecting the portion of the prior art's range of thickness and temperature, as disclosed by Sung and Houlihan or Dong, which is within the range of applicant's claims, because it has been held to be obvious to select a value in a known range by optimization for the best results, and would be an unpatentable modification, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation". *In Re Aller* 104 USPQ 233,255 (CCPA 1955); *In re Waite* 77 USPQ 586 (CCPA 1948); *In Re Swanson* 56 USPQ 372 (CCPA 1942); and *In Re Dreyfus* 24 USPQ 52 (CCPA 1934).

8. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wu (2002/0115270), Oda et al (2002/086498), and Sung (5,550,078), as applied to claim 6 above, and further of Kim (2003/0067050) and/or Dong (2003/0119256).

The references including Wu, Oda et al, and Sung teach a method for forming a device isolation film in a semiconductor device, as applied to claim 6 above.

Re claim 8, the references including Wu teach forming the gate oxidation film, but lack detailing about thickness, annealing time and temperature.

However, Sung teaches forming a gate oxidation film by thermal grown at a temperature of about 850-950°C to a thickness up to 200 Angstroms (col 5, lines 8-12). Kim teaches (at paragraph 24) forming a high voltage gate oxide film having a thickness of 300-1000 Angstroms. Dong teaches (at paragraph 27) forming a tunnel gate oxide film 28 by wet oxidation at 750-800°C and nitrogen annealing at a temperature of 900-910°C for 20-30 minutes.

Therefore, the subject matter as a whole would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the gate oxide film of the references including Wu by selecting the portion of the prior art's range of thickness and temperature, as disclosed by Sung and Kim and/or Dong, which is within the range of applicant's claims, because it has been held to be obvious to select a value in a known range by optimization for the best results, to form a high voltage transistor, and would be an unpatentable modification, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the

optimum or workable ranges by routine experimentation". *In Re Aller* 104 USPQ 233,255 (CCPA 1955); *In re Waite* 77 USPQ 586 (CCPA 1948); *In Re Swanson* 56 USPQ 372 (CCPA 1942); and *In Re Dreyfus* 24 USPQ 52 (CCPA 1934).

9. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wu (2002/0115270), Oda et al (2002/086498), and Sung (5,550,078), as applied to claim 6 above, and further of Sung et al (6,180,453) and/or Dong (2003/0119256).

The references including Wu, Oda et al, and Sung teach a method for forming a device isolation film in a semiconductor device, as applied to claim 6 above.

Re claim 9, the references including Wu teach forming the polysilicon film 202, but lack detailing about thickness, gases, pressure, and temperature as recited in claim 9.

However, Sung '078 teaches (col 5, lines 12-15) forming a polysilicon film 14 by LPCVD at a temperature of about 550-650° C using PH₃ gas and a silicon source gas, to a thickness of about 1000-4000 Angstroms. Sung et al '453 teaches (at col 3, lines 59-65) forming a polysilicon film 6 by LPCVD using PH₃ gas and a silane source gas, to a thickness of about 500-1000 Angstroms. Dong teaches (at paragraph 35-36) forming a polysilicon film by LPCVD at a temperature of about 510-550° C using PH₃ gas and a SiH₄ or Si₂H₆ source gas, to a thickness of about 500-1000 Angstroms, at pressure of 0.1 to 0.3 Torr.

Therefore, the subject matter as a whole would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the polysilicon film of the references including Wu by selecting the portion of the prior art's range of thickness, pressure, temperature, gases, as disclosed by Sung '078 and Sung et al '453, and/or Dong, which is within the range of applicant's claims, because it has been held to be obvious to select a value in a known range by optimization for the best results, and would be an unpatentable modification, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation". *In Re Aller* 104 USPQ 233,255 (CCPA 1955); *In re Waite* 77 USPQ 586 (CCPA 1948); *In Re Swanson* 56 USPQ 372 (CCPA 1942); and *In Re Dreyfus* 24 USPQ 52 (CCPA 1934).

Response to Amendment

10. Applicant's remarks submitted December 07, 2007 have been fully considered but they are not persuasive and in moot in view of the new ground(s) of rejection.

Applicant remarked (at 12/07/07 remark page 8, fourth paragraph) that "...Wu, there is no polysilicon layer during the ion implantation..."

In response, this is noted and found unconvincing. As shown in Figures 4A-4F of Wu (2002/0115270), a gate oxide film 201a and a polysilicon film 202a are subsequently formed over the substrate, wherein ions are implanted into the active region beside the trench to form the region 200b that is vertically adjacent to the polysilicon film 202a. Under the combination of references, by employing the teaching of Oda for not forming the extended buffer spacers at the trench sidewall of Wu, second ions are implanted into the semiconductor substrate at the active region and thereby vertically overlapped the polysilicon film at the corner portions of the trench, and thereby affecting and compensating for the previous implanted ions for controlling a threshold voltage, and thereby inhibiting a threshold voltage form fluctuation in upper corner portions of the trench isolation region. One cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Michael M. Trinh whose telephone number is (571) 272-1847. The examiner can normally be reached on M-F: 9:00 Am to 5:30 Pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Zandra Smith can be reached on (571) 272-2429. The central fax phone number is (703) 872-9306.

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Oacs-15

/Michael Trinh/
Primary Examiner, Art Unit 2822